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(54) **MULTI-RESERVOIR FEEDING APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 873 days.

This patent is subject to a terminal disclaimer.

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G01F 11/00 (2006.01)

(52) **U.S. Cl.**

CPC **G01F 11/006** (2013.01); **G01F 11/003** (2013.01)

(58) **Field of Classification Search**

CPC B01F 21/20; G01F 11/006; G01F 11/003
See application file for complete search history.

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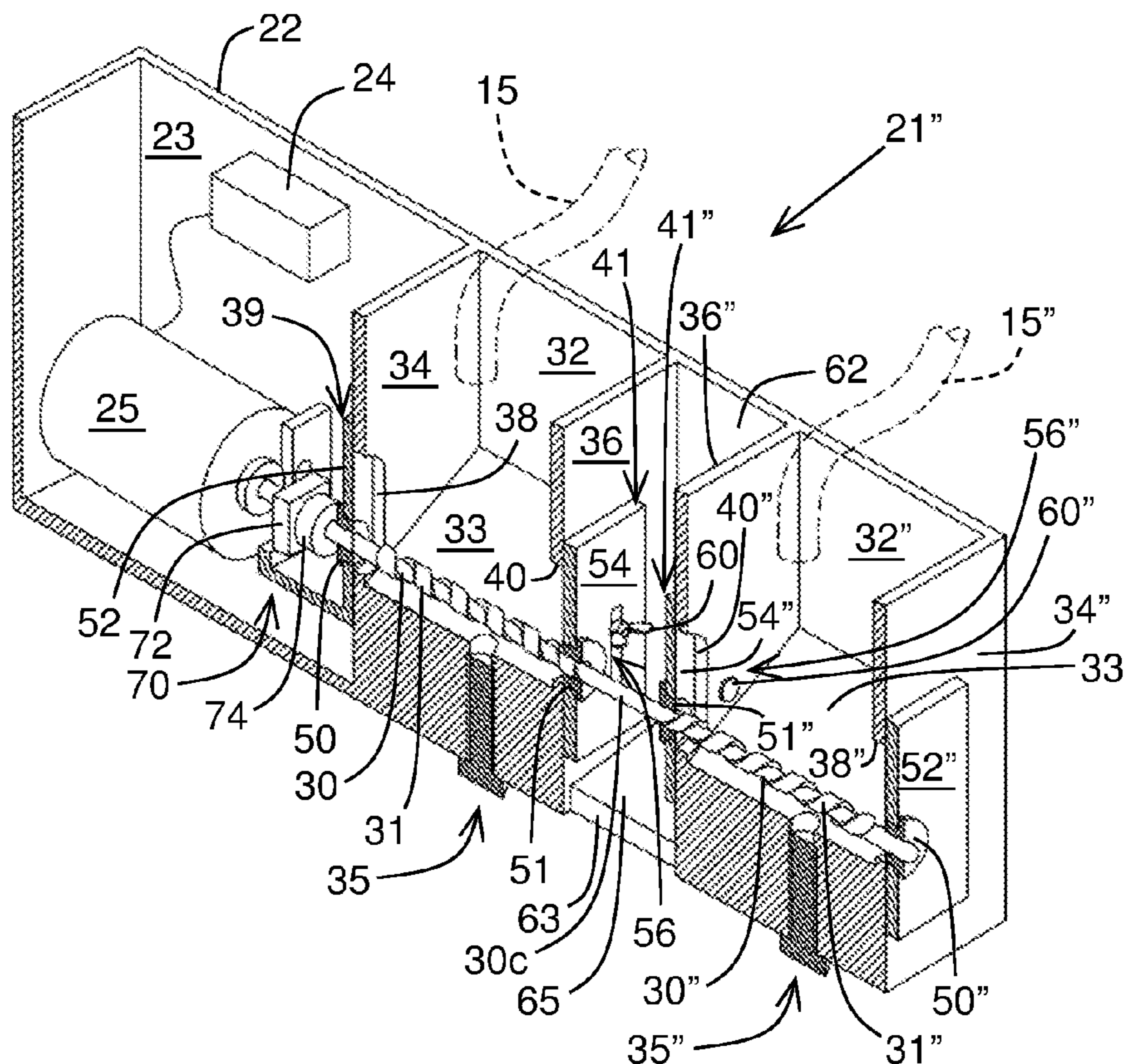
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(57) **ABSTRACT**

A multi-reservoir feeding/dosing apparatus for the delivery of at least two substances in discrete form includes first and second conveying elements coaxial to one another and in which the discharge end thereof are a close fit in a discharge bushings thereby to ensure that the correct dosage of each substance is discharged on a consistent basis. Each conveying element is in its respective reservoir. At least one motor drives both conveying elements, with each rotational direction of the motor actuating a corresponding one of the conveying elements.

8 Claims, 5 Drawing Sheets



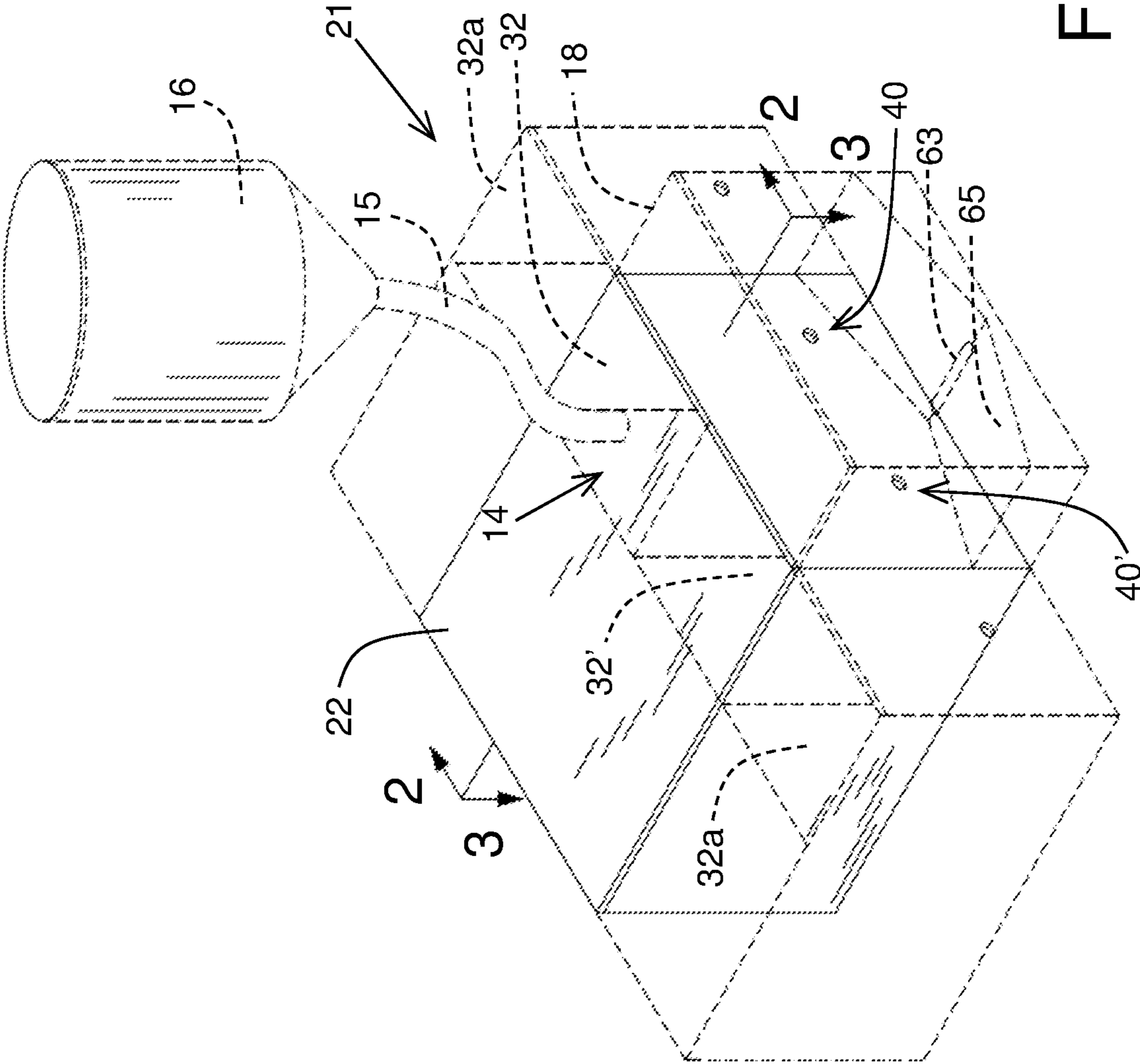


Fig.1

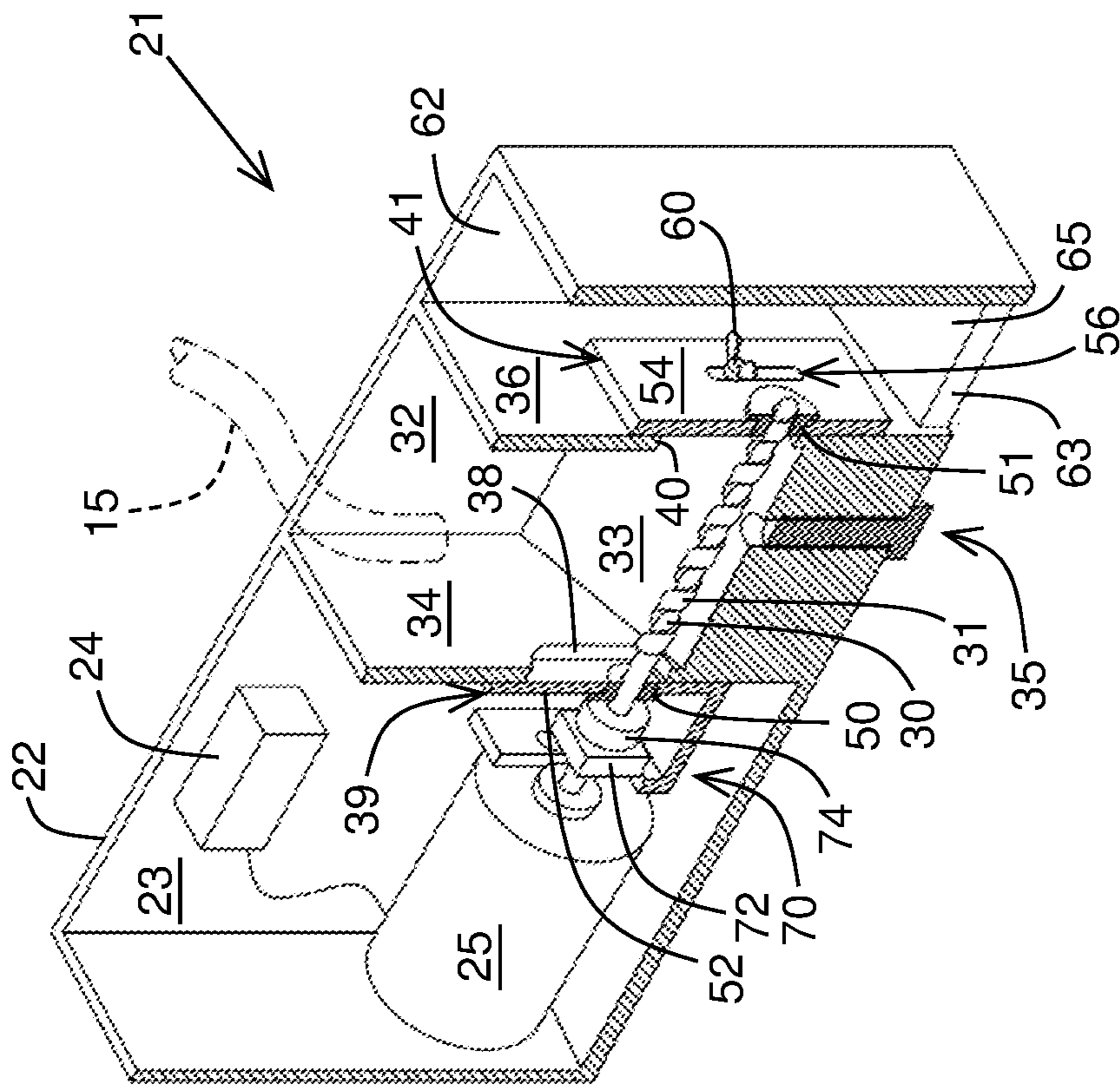


Fig. 2

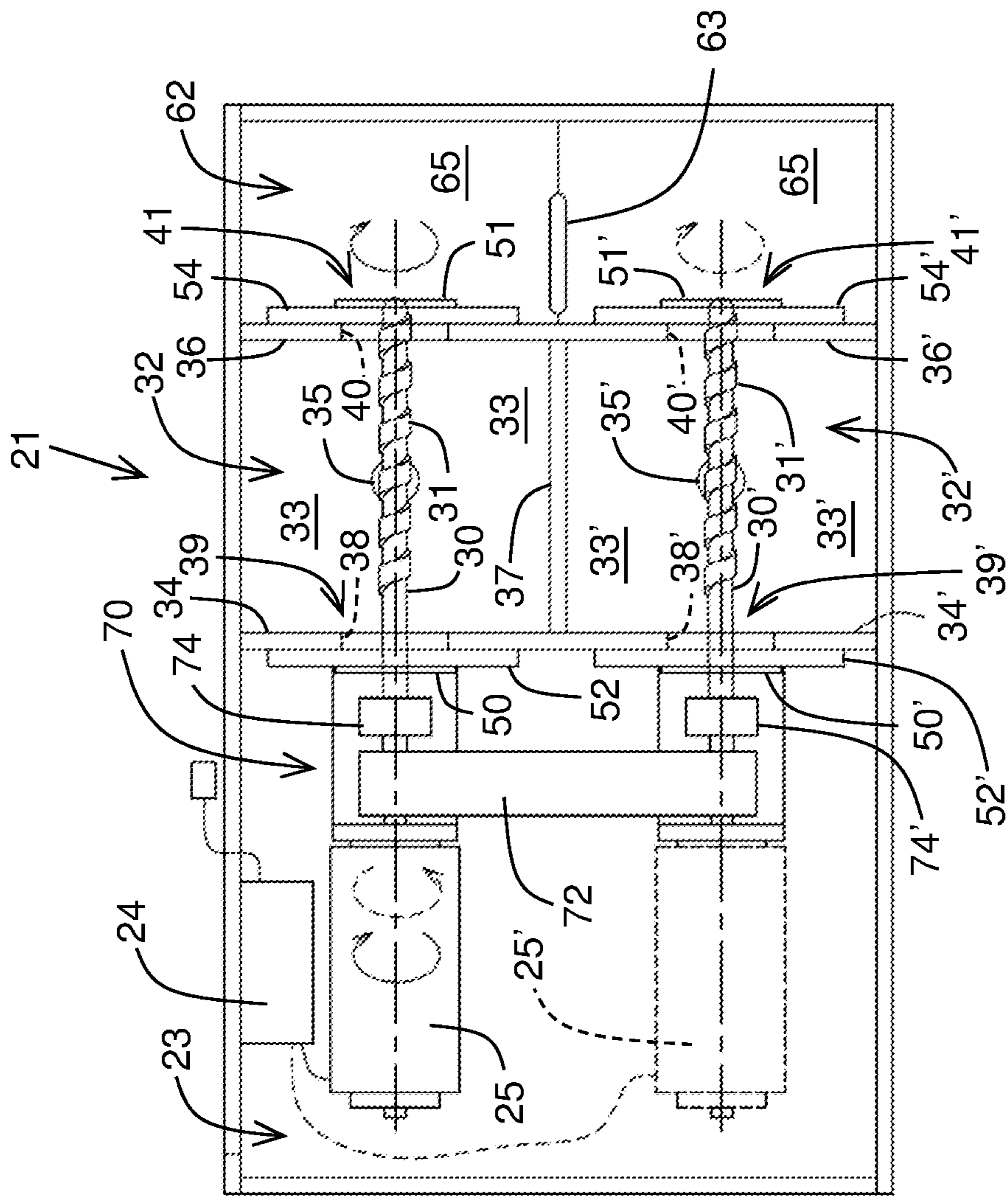


Fig. 3

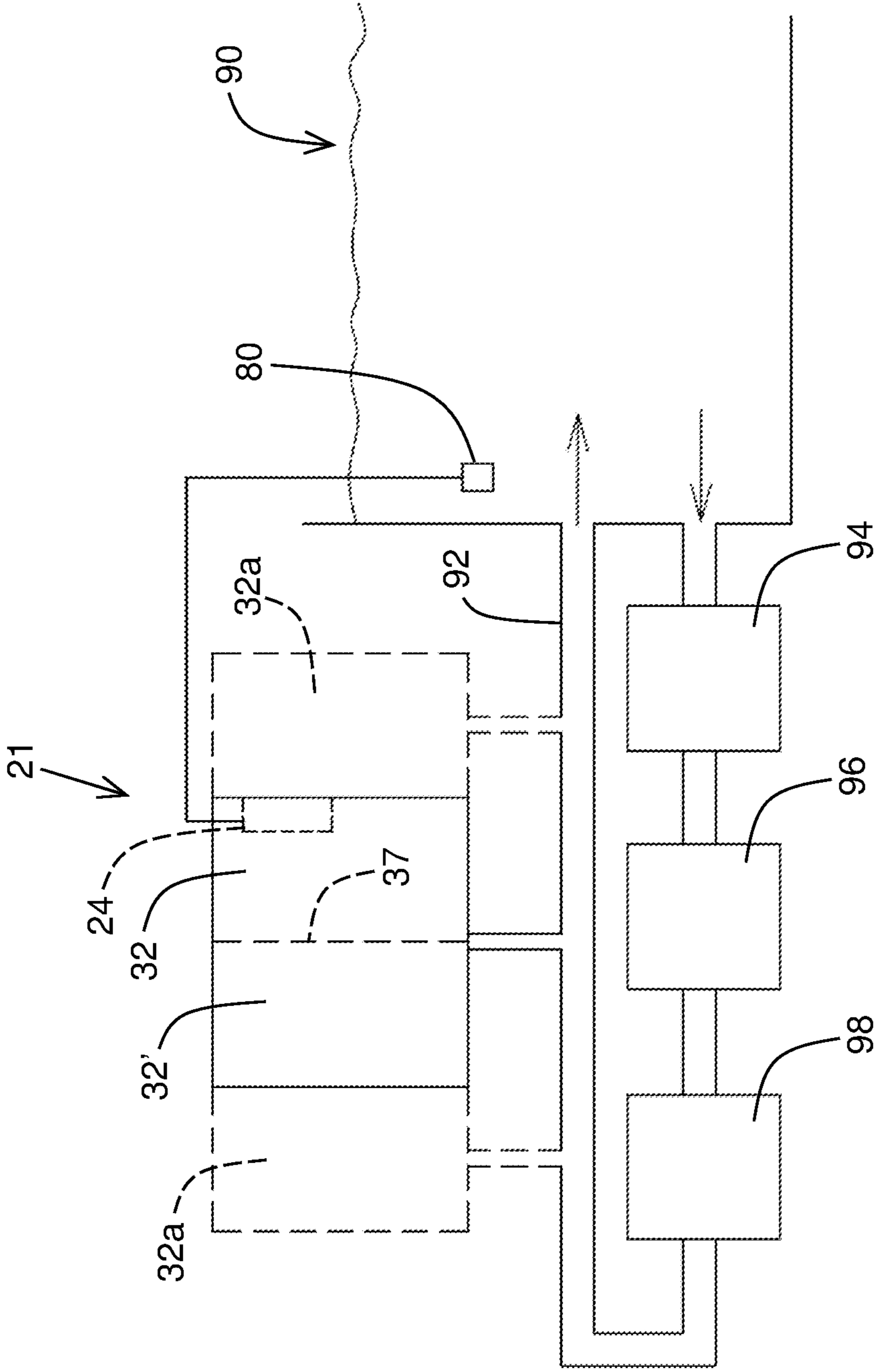


Fig.4

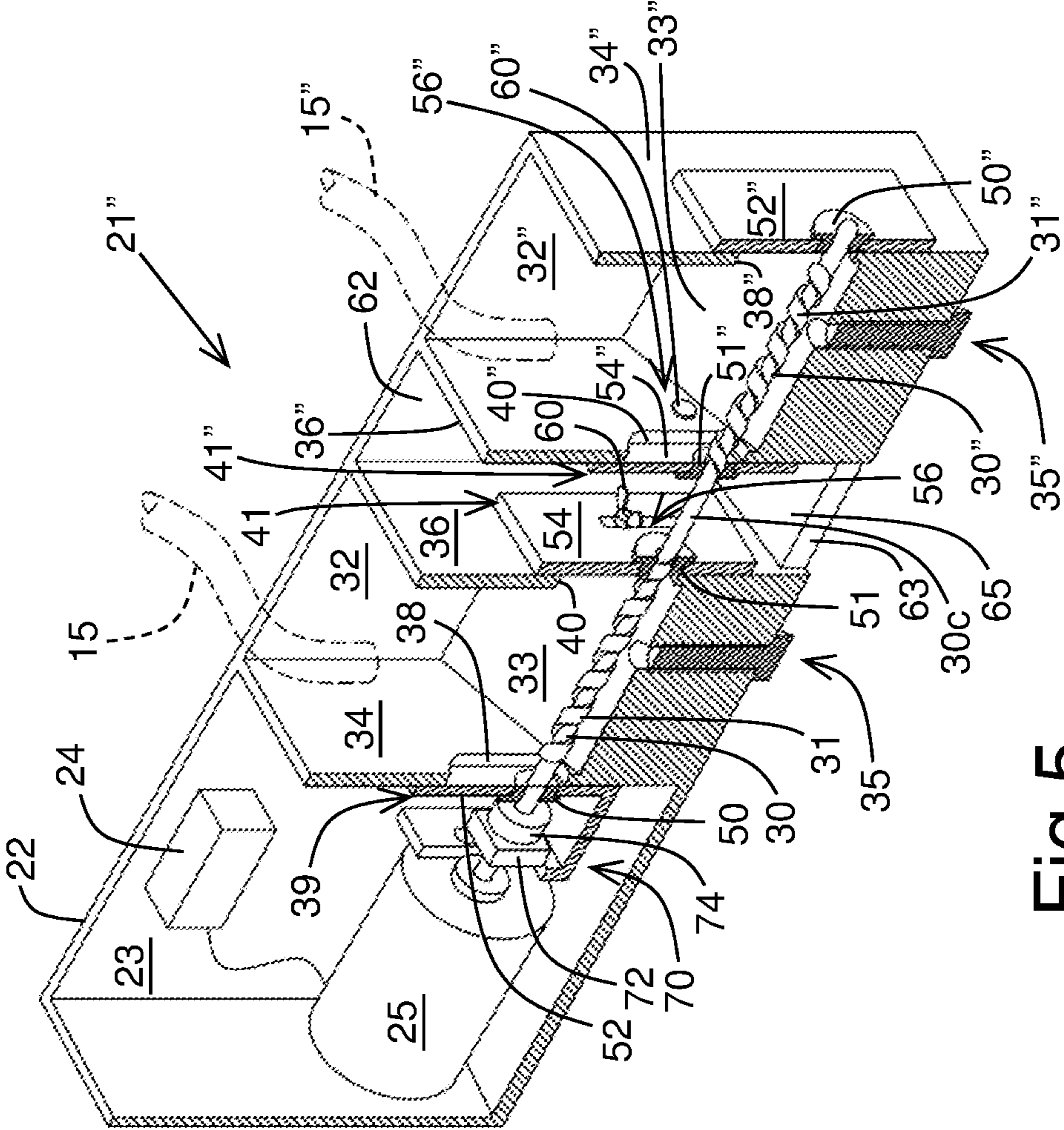


Fig. 5

MULTI-RESERVOIR FEEDING APPARATUS**CROSS REFERENCE TO RELATED APPLICATIONS**

This application is a continuation-in-part (C.I.P.) application of patent application Ser. No. 16/083,183, filed on Sep. 7, 2018, which is a National Phase Entry of PCT application serial No. PCT/CA2017/050311 filed on Mar. 8, 2017, which claims the benefits of U.S. provisional application Ser. No. 62/305,240, filed on Mar. 8, 2016, and all of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

The present invention relates to feeding apparatuses, and is more particularly concerned with such an apparatus having multiple reservoirs for automatically, or manually, dosing powder, or granular or other substances in discrete form.

BACKGROUND OF THE INVENTION

It is well known in the art to provide apparatus for the delivery of such materials as mentioned above at predetermined rates, namely in prescribed dosages, in for example the chemical or pharmaceutical industries where consistent accuracy is an important requirement for their processes.

Various types of dosing/feeding apparatus have been proposed and include inter alia those employing pocketed rotors, or screw feeders in either the vertical or horizontal orientations feeding particulate substances in granular, pulverulent or generally discrete form continuously or intermittently as demanded by the relevant processes.

One of the problems attendant upon the usage of conventional apparatus is in maintaining the accuracy requirement in view of the predisposition of the driving elements to become contaminated and in so doing to affect the quantitative performance of the apparatus on a temporal basis. Accordingly, the efficacy of the apparatus is compromised, as is the process for which it is being employed. Furthermore, in order to provide accurate dosage, one must ensure that there is always feeding substance flowing through the discharge outlet, with the space between the discharge opening and the conveying element is substantially entirely filled, with no void left because of too large particle that cannot enter the space.

This is especially important when dealing with the control of the acidity level of a fluid like water of a spa, swimming pool or the like, where the feeding substance is either one of an acid or a base, depending on the actual acidity level of the fluid to be treated relative to the targeted level. In addition to the accurate dosage of either substance that is required, the available space for the feeding apparatus is usually limited.

Accordingly, there is a need for an improved dosing/feeding apparatus.

SUMMARY OF THE INVENTION

It is therefore a general object of the present invention to provide an improved dosing/feeding apparatus.

An advantage of the present invention is that the dosing/feeding apparatus provides for consistency of delivery rates in the absence of any significant variation in quantity, for either substance.

Another advantage of the present invention is that the feeding apparatus is simple in construction and operation, with the control of either motor, or of the rotational direction of a motor connected to two conveying elements referring to respective reservoirs of feeding substances, such as acid and base substances.

A further advantage of the present invention is that the feeding apparatus has easily replaceable parts and its adjustment is facilitated thereby.

Still another advantage of the present invention is that the feeding apparatus provides for variations in the manner of dosage delivery.

Yet another advantage of the present invention is that the feeding apparatus is intended and capable of continuous operation, as 24 hours a day, 7 days a week.

Yet a further advantage of the present invention is that the feeding apparatus could be small in size so as to fit in tiny spaces.

According to an aspect of the present invention, there is provided a multi-reservoir feeding/dosing apparatus for feeding at least first and second substances in discrete particulate form, the feeding apparatus comprising:

a first reservoir for receiving the first substance therein and having an inlet for the introduction of the first substance thereto and a first outlet for the egress of the first substance therefrom, a first conveying element having an inlet end and a discharge end, each end being mounted in a respective bushing and the first conveying element extending through the first reservoir and adapted to convey the first substance in predetermined dosages from the first reservoir to the first outlet thereof for delivery therefrom;

a second reservoir for receiving the second substance therein and having an inlet for the introduction of the second substance thereto and a second outlet for the egress of the second substance therefrom, a second conveying element having an inlet end and a discharge end, each end being mounted in a respective bushing and the second conveying element extending through the second reservoir and adapted to convey the second substance in predetermined dosages from the second reservoir to the second outlet thereof for delivery therefrom;

at least one motor operatively connected to the first and second conveying elements; and

a controller unit operatively connecting to the at least one motor to drive the first and second conveying elements upon rotation into first and second rotational directions, respectively.

In one embodiment, the at least one motor operatively connects to the first and second conveying elements via a coupling mechanism.

Conveniently, the coupling mechanism includes respective first and second free wheel sprockets allowing operation of the first and second conveyor elements upon the at least one motor being operated into the first and second rotational directions, respectively.

Conveniently, the apparatus further includes a sensor unit connecting to the controller unit for sensing an actual parameter level of a fluid, and the first and second outlets being in fluid communication with the fluid, and wherein the controller unit, upon the actual parameter being smaller or larger than a predetermined parameter level, operates the at least one motor into the first and second rotational directions, respectively, for feeding of the first and second substances into the fluid.

Conveniently, the controller unit, depending on a difference between the actual and predetermined parameter levels, operates the at least one motor into the first or second rotational direction for a calculated time duration to ensure the predetermined dosage of the first or second substance into the fluid.

In one embodiment, the at least one motor includes first and second motors operating the first and second conveying elements, respectively.

According to another aspect of the present invention, there is provided a multi-reservoir feeding/dosing apparatus for feeding first and second substances in discrete particulate form, the feeding apparatus comprising:

a first reservoir for receiving the first substance therein and having an inlet for the introduction of the first substance thereto and a first outlet for the egress of the first substance therefrom, a first conveying element having an inlet end and a discharge end, each end being mounted in a respective bushing and the first conveying element extending through the first reservoir and adapted to convey the first substance in predetermined dosages from the first reservoir to the first outlet thereof for delivery therefrom;

a second reservoir for receiving the second substance therein and having an inlet for the introduction of the second substance thereto and a second outlet for the egress of the second substance therefrom, a second conveying element having an inlet end and a discharge end, each end being mounted in a respective bushing and the second conveying element extending through the second reservoir and adapted to convey the second substance in predetermined dosages from the second reservoir to the second outlet thereof for delivery therefrom;

the first and second conveying elements being coaxial to one another, and having first and second threads, respectively, the first and second threads being reverse to one another;

a motor operatively connected to the first and second conveying elements; and

a controller unit operatively connecting to the motor to drive the first and second conveying elements upon rotation into first and second rotational directions, respectively.

In one embodiment, the first and second conveying elements are both extending from a common shaft.

Conveniently, the motor is a step-motor.

Other objects and advantages of the present invention will become apparent from a careful reading of the detailed description provided herein, with appropriate reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Further aspects and advantages of the present invention will become better understood with reference to the description in association with the following Figures, wherein:

FIG. 1 is a simplified front perspective view of a multi-reservoir feeding/dosing apparatus in accordance with an embodiment of the present invention;

FIG. 2 is a sectioned top perspective view taken along line 2-2 of FIG. 1, showing the inside of the apparatus;

FIG. 3 is a sectioned plan view taken along line 3-3 of FIG. 1; and

FIG. 4 is a schematic diagram of the embodiment of FIG. 1 used to control parameters of the water of a spa or the like, and

FIG. 5 is a view similar to FIG. 2 of an apparatus in accordance with another embodiment of the present invention, showing the inside of the apparatus.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the annexed drawings the preferred embodiments of the present invention will be herein described for indicative purpose and by no means as of limitation with like numerals of reference being employed for like parts in differing embodiments of the invention or its details.

Referring first to FIG. 1, there is shown an exterior view of one embodiment of a multi-reservoir feeding/dosing apparatus in accordance with an embodiment 21 of the present invention and including a housing 22 encasing at least two reservoirs 32, 32', 32a, 32" with inlet conduits 14 fed through tubes 15 from elevated hoppers 16. A receptacle 18 is illustrated in ghosted outline and serves to receive dosed deliveries of at least two substances from the at least two reservoirs, the deliveries being effected by conveying elements (not shown) which engage bushings 51 in the outlets 40, 40' of the reservoirs 32, 32'.

Turning now to FIGS. 2 and 3 the inside of the multi-reservoir feeding apparatus 21 is illustrated. A housing 22 defines a drive chamber 23 enclosing at least one motor 25 controlled in programmable fashion by a programmer or controller unit 24, such as using a potentiometer or the like. The motor 25 is coupled to and is adapted to drive at least a first conveying element 30, which extends through a first reservoir 32 at the relatively lower end thereof adjacent its sloping base 33, which is provided with a plugged drain 35. The first reservoir 32 is defined between two vertical compartmentalizing walls 34, 36 each of which is appropriately pierced as at 38, 40 respectively to provide a mounting zone 39, 41 for the first conveying element 30. The first conveying element 30 is held at each end thereof in a bushing 50, 51 providing a wiping seal to give a tight fit for the drive end and the discharge end of the element. The bushings 50, 51 are held in a mounting block 52, 54 respectively each of which is adjustable through the agency of a pin and slot arrangement 56 or the like securable in position by the application of pressure provided by wing-nuts 60 or the like. A receptacle 62 for the reception in use of dosages of a first substance delivered by the first conveying element 30 through the outlet bushing 51 is located contiguous with the first reservoir 32. The receptacle 62 has a discharge outlet 63 in its sloping base 65.

Similarly, the motor 25 is typically coupled to and is adapted to drive a second conveying element 30', which extends through a second reservoir 32', essentially adjacent the first reservoir 32 and separated therefrom by mid wall 37, at the relatively lower end thereof adjacent its sloping base 33', which is provided with a plugged drain 35'. The second reservoir 32' is defined between two vertical compartmentalizing walls 34', 36' (such as extensions of walls 34, 36 respectively) each of which is appropriately pierced as at 38', 40' respectively to provide a mounting zone 39', 41' for the second conveying element 30'. The second conveying element 30' is held at each end thereof in a bushing 50', 51' providing a wiping seal to give a tight fit for the drive end and the discharge end of the element. The bushings 50', 51' are held in a mounting block 52', 54' respectively each of which is adjustable through the agency of a pin and slot arrangement 56' or the like securable in position by the application of pressure provided by wing-nuts 60' or the like.

The receptacle **62** for also the reception in use of dosages of a second substance delivered by the second conveying element **30** through the outlet bushing **51'** is located contiguous with the second reservoir **32'**.

The first **30** and second **30'** conveying elements are each typically in the form of an auger with a scrolled flight **31, 31'** which in use serves to move and thus convey the first and second substances within the first **32** and second **32'** reservoirs through the outlets **40, 40'** to the receptacle **62**.

Typically, the motor **25** is coupled to the first **30** and second **30'** conveying elements via a coupling mechanism **70** which includes a gear box **72** coupled to respective first **74** and second **74'** free wheel sprockets allowing operation of the first **30** and second **30'** conveyor elements upon the motor **25** being operated into first and second rotational directions, respectively, as illustrated in FIG. 3.

Although not illustrated herein, it would be obvious to one skilled in the art, without departing from the scope of the present invention, to have one motor **25, 25'** per conveying element **30, 30'**.

As shown in FIG. 4, the apparatus **21** can include at least one sensor unit **80** connected to the controller unit **24** for sensing a corresponding actual parameter level of a fluid, as water in a spa **90** or the like, being in fluid communication with the discharge outlet **63** along a fluid circulation conduit **92** including usual fluid pump **94**, filter **96**, and heater **98**.

In operation, first and second substances in discrete form, for example powder or granules, could be held in hoppers **6** and gravitationally feed through the tubes **5** into the reservoirs **32, 32'** where the substances are supported by the sloping bases **33, 33'** and between the walls **34, 36** and **34', 36'**. Actuation of the motor **25**, in either rotational direction, in accordance with a programmed dosing regime on a temporal basis, e.g. g/min, g/hr, is instigated with the result that the corresponding conveying element **30, 30'** rotates and in so doing its flight **31, 31'** picks up the corresponding substance and scrolls it towards the outlet bushing **51, 51'**. It will be understood by the skilled addressee that since the auger lies and rotates within the body of the substance in the corresponding reservoir **32, 32'**, the outer surface of the flight **31, 31'** is in contact with that substance and may attract particles which are carried thereby towards the outlet bushing **51, 51'**. However, in view of the tight fit of the discharge end of the conveying element **30, 30'** within its bushing **51, 51'**, the particles so attracted are in effect barred from entering the outlet bushing **51, 51'** and thus the predetermined dosage maintains its accuracy since it is not contaminated by inadvertent carriage of particle adhering to the outer surface of the scroll flight **31, 31'**.

The substance discharged through the outlet bushing **51, 51'** descends as illustrated in FIG. 3 into the receptacle **62** onto the sloping base **65** and falls through the discharge outlet **63** for predestined use in a relevant process which could be for example chemical or pharmaceutical in character, such as the two substances being an acid and a base substance used to control the acidity or pH level of a fluid (as the water of a spa or the like), since at each time, either one of the two substances need to be fed.

To this end, the controller unit **24**, upon the actual parameter sensed from the sensor unit **80** being smaller or larger than a predetermined parameter level, operates the motor **25** into the first or second rotational direction, respectively, for feeding of the first or second substances into the fluid. Similarly, the controller unit **24**, depending on a difference between the actual and predetermined parameter levels, operates the motor **25** into the first or second rotational direction for a calculated time duration, or a calculated

rotational angle of the conveying element **30, 30'** to ensure the predetermined dosage of the first or second substance is fed into the fluid.

Although the feeding/dosing apparatus could be deployed for the controlled feeding of animals and such application may be particularly useful for intensive farming, where regular and closely monitored and accurate feeding of the animals is necessary, similarly to the feeding of chemical nature as for the acidity level control of the water of a spa, swimming pool or the like. The programming of the motor operation may not only dictate the volume of the feed, but also the duration and number of times the motor is actuated. In such a case, when accuracy is required, a stepper motor (or step-motor) would be more suitable than any other type of motors.

Now referring more specifically to FIG. 5, there is shown a multi-reservoir feeding/dosing apparatus in accordance with an embodiment **21"** of the present invention in which, similarly to embodiment **21**, the two reservoirs **32, 32"**, fed with first and second substances via respective tube **15, 15"**, instead of being positioned side-to-side (as shown in FIGS. 1-3), they could be positioned back-to-back with the two conveying elements **30, 30"** being coaxial relative to one another, and preferably being a same element (common shaft), typically in the form of an auger, but having reverse threads or flights **31, 31"** such that, depending on the rotational direction of the conveying element **30, 30"**, either one of the first and second substances is fed via its respective outlet **40, 40"**. Similarly to embodiment **21**, the second conveying element **30"** of embodiment **21"** extends through the reservoir **32"** at the relatively lower end thereof adjacent its sloping base **33"**, which is provided with a plugged drain **35"**. Reservoir **32"** is defined between two vertical compartmentalizing walls **34", 36"** each of which is appropriately pierced as at **38", 40"** respectively to provide a mounting zone **39", 41"** for the second conveying element **30"**. The second conveying element **30"** is held at each end thereof in a bushing **50", 51"** providing a wiping seal to give a tight fit for the drive end and the discharge end of the element **30"**. The bushings **50", 51"** are held in mounting blocks **52", 54"**, respectively, each of which is adjustable through the agency of a pin and slot arrangement **56"** or the like securable in position by the application of pressure provided by wing-nuts **60"** or the like. The receptacle **62** for the reception in use of dosages of both the first and second substances delivered by the first conveying elements **30, 30"** through the outlet bushings **51, 51"** is located contiguous with and in-between the first and second reservoirs **32, 32"**. The receptacle could also be divided into two to provide two separate discharge outlets. It is noted that the directional substance feeding of both flights **31, 31"** could be interchanged, in which case, the central receptacle **62** would be replaced with two separate receptacles at opposite ends (with the two reservoirs in a back-to-back configuration).

In such embodiment shown in FIG. 5, when precise feeding is required, the controller unit **24** may have to account for an additional rotational angle due to a 'reset' of the corresponding feeding element (before it will actually start delivering the corresponding substance) when the previous feeding was for the other substance (in the reverse rotational direction which induced a back-off of the substance ready for being delivered).

Although not illustrated herein, it would be obvious to one skilled in the art, without departing from the scope of the present invention, to have, with the central portion **30c** of the conveying element (between the two element **30, 30"**) being absent—therefore disconnecting both coaxial elements **30,**

30" from each other—one motor 25 per conveying element 30, 30" could be contemplated. Similarly, with the two conveying elements 30, 30" separated from one another but with a same direction threads or flights 31, 31", the motor 25 could be used with a gear box 72 connected to both elements 5 30, 30" via respective first and second free wheel sprockets 74 (to ensure only one element 30, 30" is activated at a time, depending on the directional rotation of the motor 25), similarly to the embodiment illustrated in FIG. 3, without departing from the scope of the present invention. In such a 10 case, the two discharge outlets could be located wherever appropriate or desired.

Although partially illustrated in FIG. 1 in stippled lines, more than the two reservoirs 32, 32' can be considered without departing the scope of the present invention. Each of 15 these additional reservoirs 32a, for example, has its own conveying element with its drive motor for feeding a corresponding substance into the fluid. Additional corresponding sensors, sensing respective parameters of the fluid, connected to the controller unit 24 could determine the need 20 to feed the corresponding substance, and the specific required amount thereof, into the fluid.

Although the present invention of a multi-reservoir feeding/dosing apparatus has been described with a certain 25 degree of particularity, it is to be understood that the disclosure has been made by way of example only and that the present invention is not limited to the features of the embodiments described and illustrated herein, but includes all variations and modifications within the scope and spirit of the invention as hereinafter claimed.

The invention claimed is:

1. A feeding apparatus for feeding first and second substances in discrete particulate form, the feeding apparatus comprising:

a first reservoir for receiving the first substance therein 35 and having an inlet for the introduction of the first substance thereto and a first outlet for the egress of the first substance therefrom, a first conveying element having an inlet end and a discharge end, each end being mounted in a respective bushing and the first conveying 40 element extending through the first reservoir and adapted to convey the first substance in predetermined dosages from the first reservoir to the first outlet thereof for delivery therefrom;

a second reservoir for receiving the second substance 45 therein and having an inlet for the introduction of the second substance thereto and a second outlet for the egress of the second substance therefrom, a second

conveying element having an inlet end and a discharge end, each end being mounted in a respective bushing and the second conveying element extending through the second reservoir and adapted to convey the second substance in predetermined dosages from the second reservoir to the second outlet thereof for delivery 5 therefrom;

the first and second conveying elements being coaxial to one another, and having first and second threads, respectively, the first and second threads being reverse to one another;

a motor operatively connected to the first and second conveying elements; and

a controller unit operatively connecting to the motor to drive the first and second conveying elements upon rotation into first and second rotational directions, 10 respectively.

2. A feeding apparatus as claimed in claim 1, wherein the motor operatively connects to the first and second conveying elements via a coupling mechanism.

3. A feeding apparatus as claimed in claim 2, wherein the coupling mechanism includes respective first and second free wheel sprockets allowing operation of the first and second conveyor elements upon the motor being operated 15 into the first and second rotational directions, respectively.

4. A feeding apparatus as claimed in claim 1, wherein the first and second conveying elements are both extending from a common shaft.

5. A feeding apparatus as claimed in claim 4, wherein the 20 motor is a step-motor.

6. A feeding apparatus as claimed in claim 4, further including a sensor unit connecting to the controller unit for sensing an actual parameter level of a fluid, and the first and second outlets being in fluid communication with the fluid, and wherein the controller unit, upon the actual parameter 25 being smaller or larger than a predetermined parameter level, operates the motor into the first and second rotational directions, respectively, for feeding of the first and second substances into the fluid.

7. A feeding apparatus as claimed in claim 6, wherein the controller unit, depending on a difference between the actual and predetermined parameter levels, operates the motor into the first or second rotational direction for a calculated time duration to ensure the predetermined dosage of the first or 30 second substance into the fluid.

8. A feeding apparatus as claimed in claim 1, wherein the motor is a step-motor.

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